COMMONWEALTH OF AUSTRALIA

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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2, 2016

FINAL EXAMINATION	**DURATION**
ENG429 – Biomedical Engineering	Reading Time: **10** minutes Writing Time: **180** minutes

INSTRUCTIONS TO CANDIDATES

Please **do not use** pale fine blue pens or pencil, please **use** a dark blue or black pen

This paper consists of thirty eight (38) questions. You are required to answer any twenty five (25) questions.

Each question is worth 4 marks. The total mark for this examination is 100.

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is an OPEN BOOK examination

Any non-programmable calculator is permitted

Any handwritten material is permitted

Any hard copy, English dictionary is permitted (annotated allowed)

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
Any printed material with the exception of CDU Library books	1 x 20 Page Book

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Answer any 25 Questions.
Each question is worth 4 marks.

1. Describe the mechanism of an action potential.

2. For the muscle of a certain animal the typical values for intracellular and extracellular concentrations of ions are as follows

Ion	Intracellular	Extracellular
Na^+	12	145
K^+	155	4
Cl^-	4	120

   At room temperature the typical permeability coefficients are P_{Na} = 2 x 10^{-8} cm/s, P_K = 2 x 10^{-6} cm/s and P_{Cl} = *4* x 10^{-6} cm/s. *kT/q* at room temperature is approximately 26. Find the membrane potential, using the Goldmann equation.

3. How can the strength of muscle contraction be increased ?

4. Why would the following not be a good idea:

   a. A metal tube blood vessel replacement
   b. A silicone rubber for ligament or tendon replacement
   c. A silicone rubber pin for fixing a bone fracture
   d. A ceramic skin graft

5. Describe how a bone fracture is repaired

6. Give three examples of therapeutic devices. Choose one of them and describe how it works.

7. A person is exposed to a certain potential difference. What factors determine the physiological effects on his body? .

8. Name three method of making an image of (part of) the human and give an example of a possible use for each of them.

9. List three factors which influence the growth of bone.

10. What methods can be used to investigate brain function?

11. How can a capacitor be used as a motion sensor? Give a possible application.

12. You are asked to design a remote monitoring system for a Mount Everest expedition. What variable would you want to monitor? Explain your answer .

13. Give some medical applications of electric stimulators.

14. An artificial heart valve has been used for a number of years and there is some concern that it might fail. What part of the valve do you expect to fail first? Explain your answer.

15. A patient has been provided with a new prosthesis. How can you investigate whether this prosthesis is functioning satisfactory ?

16. Explain how kidney stones can be removed without requiring general anesthetics.

17. A biosensor for calcium has been implanted into muscle. The signals are monitored for several days successfully. However, from day 10 onwards the signal starts to get much weaker and the sensor does not detect much calcium anymore. Why might the sensitivity of a sensor decrease after implantation in a tissue?

18. Some implantable drug delivery systems can be controlled by the patient. Explain how this is done and give an example of an application of such a drug delivery system.

19. The interfaces are often the main challenge in designing and constructing artificial joints. Explain what the relevant interfaces are for an artificial hip joint and what the main challenges are with each interface.

20. What imaging techniques have been affected by the increase in computing power? Explain your answer.

21. What were the challenges that had to be overcome to develop functional cochlear implants? Explain your answer.

22. A biomedical sensor does not seem to give correct information. List some potential causes for this problem.

23. Besides the strength of a material, what other properties of materials need to be considered if the material is used for biomedical purposes and what tests are available to determine what these properties are?

24. How can a piezo-electric transducer be used to measure the thickness of an object?

25. Why is it important to keep the temperature within narrow limits in an infant incubator? Is it useful to place the temperature sensor directly on the body of the infant? Explain your answer.

26. What are the physical principles on which fluid dynamics is based?

27. What is relevance of the color of blood?

28. What is a motor unit?

29. Describe the atria and the ventricles, including wall thickness and patterns of blood flow through these chambers.

30. What is impedance plethysmography?

31. Explain in terms which a person without any technical knowledge would understand what a Fourier transform is.

32. Why is it important that the blood pressure remains within certain limits (not too high not to low)?

33. Trace the path of a single red blood cell from a capillary bed in your big toe to the capillary bed of your right lung and back. What gases are exchanged in the process?

34. What is a stress-strain curve and what is its relevance for Biomedical Engineering?

35. A cricket umpire likes eating chocolate. The result of this is that she has several dental fillings. One day she receives some chocolate from a few players who intent to bribe her. Still looking at the match she puts the chocolate in her mouth, not noticing that it is still wrapped in aluminium foil. Will her experience depend on the type of material used for her fillings (amalgam or ceramics)? Explain your answer.

36. Compare and contrast MRI and ultrasound.

37. In your opinion, what is the most important development in medicine or biomedical engineering *after* 1955? Explain your answer .

38. What advances in biomedical engineering do you expect in the next two decades?